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SPECIFICATION

**INVENTION:** LEG HOLDER SYSTEM FOR SIMULTANEOUS POSITIONING IN THE ABDUCTION AND LITHOTOMY DIMENSIONS


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# LEG HOLDER SYSTEM FOR SIMULTANEOUS POSITIONING IN THE ABDUCTION AND LITHOTOMY DIMENSIONS

## FIELD OF INVENTION

This invention relates to an improved leg holder system and more particularly to such a system in which adjustment in both the lithotomy and abduction dimensions can be made simultaneously with a single action.

## BACKGROUND OF INVENTION

In recent years many newer surgical procedures have required interoperative positioning of patients legs. Until recently such positioning typically required adjusting the leg holder's mounting clamp located on the surgical table siderail, beneath the sterile drape. This raised concerns about possible violation of the sterile field and it limited the performance of such adjustments to non-sterile personnel. Recent attempts to solve this problem yielded leg holders that could be raised and lowered through the drapes, however, they have several limitations. First, when adjusted upwardly they lock by means of a ratchet mechanism; this mechanism does not prevent further unintended upward movement of the legs that could result from tilting the patient in the extreme head down direction "Trendelenburg" or from surgical staff leaning against the leg holder. Secondly, abduction is predetermined and cannot be adjusted without accessing the mounting clamp.

## SUMMARY OF INVENTION

It is therefore an object of this invention to provide an improved leg holder system.

It is a further object of this invention to provide such a system with which both the lithotomy and abductions for a leg holder can be adjusted with a single action with one hand.

It is a further object of this invention to provide such a system which permits adjustment without violating the sterile field.

It is a further object of this invention to provide such a system which prevents further inadvertent upward movement even when the patient is tilted in the extreme head down or Trendelenburg direction.

It is a further object of this invention to provide such a system which when locked prevents movement in all directions.

It is a further object of this invention to provide such a system which permits a full abduction adjustment range throughout the full lithotomy range.

It is a further object of this invention to provide such a system which the clamps are normally locked and must be activated for release.

It is a further object of this invention to provide such a system which release of the actuation of the clamps causes them to default to the locked condition.

It is a further object of this invention to provide such a system in which the clamps are remotely operable.

It is a further object of this invention to provide such a system in which the clamping operation is accomplished through the same instrumentality as the re-positioning of the leg holders.

It is a further object of this invention to provide such a system in which the leg holders are counterbalanced for reducing the load encountered by the user with a patient in place.

It is a further object of this invention to provide such a system in which the operation of the clamping means can be accomplished with the same action as the repositioning of the leg holders or can be decoupled for independent operation.

This invention results from the realization that a truly simple, fail-safe leg holder system which enables simultaneous positioning in the abduction and lithotomy dimensions with a single action outside the sterile field can be effected using an actuator that is normally biased to clamp both the leg cradle support device and a mounting device which have a mutually transverse axes and under control of a remote operator simultaneously releases the clamping force in both devices to enable movement of the support device about both axes for repositioning in both the abduction and lithotomy dimensions.

This invention features a leg holder system for simultaneous positioning in the abduction and lithotomy dimensions. There is a support device for supporting a leg cradle and a clamping device for mounting the proximate end of the support device to a mounting device having a first axis and selectively clamping and releasing motion of the support device about the first axis and about a second axis transverse to the first axis. An actuator device actuates the clamp to selectively clamp and release simultaneously the support device and the mounting device. An operator device remote from the clamping device and actuator device operates the actuator device to enable the support device to move simultaneously about both the first and second axes in the abduction and lithotomy dimensions.

In a preferred embodiment the clamping device may include a pair of pressure blocks a first recess for receiving the mounting device and a second recess for receiving a support device. The clamping device may include a device for biasing the blocks to normally produce friction between the recesses and their respective mounting and support devices to clamp them in position. The actuator device may include an actuator rod extending with a support device. The support device may include a bore and the actuator rod may be disposed in the bore. The actuator device may include a camming device fixed to the actuator rod and a follower device disposed in the clamping device and responsive to the camming device for opposing the biasing device to simultaneously decrease the friction force on the support device and on the mounting device to release the clamping device in both axes. The operator device may include a handle for both operating the actuator device to remotely release and secure the clamping device to the support device and the mounting device and to position the support device in the abduction and lithotomy dimensions. The support device may include a resilient device for counterbalancing the weight of the leg holder. The axis of the handle may be coincident with the axis with the actuator rod for independent actuation of the clamping device and motion of the support device in the lithotomy and abduction dimensions. The handle may include a rotatable sleeve. The support device may include a leg cradle bracket for mounting a leg cradle spaced from the axis of the support means. The actuator device may include a limiter device for arresting movement of the camming device before its highest position to enable the biasing device to back-drive the camming device when the operator device is released and automatically reestablish the clamping function between the recesses and the support and mounting devices.

## DISCLOSURE OF PREFERRED EMBODIMENT

Other objects, features and advantages will occur to those skilled in the art from the following description of a preferred embodiment and the accompanying drawings, in which:

FIG. 1 is a detailed sectional view of a leg holder system with portions broken away and foreshortened of a leg holder system according to this invention;

FIG. 2 is a view similar to FIG. 1, with the support device rotated 90°;

FIG. 3 is an exploded view of the leg holder system shown in FIGS. 1 and 2;

FIG. 4 is a pair of leg holder systems according to this invention as shown in FIGS. 1, 2 and 3 installed on an x-ray table with leg cradles and leg cradle clamps installed and employing gas cylinder lift assistance devices;

FIG. 5 is a view similar to FIG. 4 with the leg cradles repositioned with greater abduction and lesser lithotomy; and

FIG. 6 is a view similar to FIG. 4 with the leg cradles repositioned with greater lithotomy and lesser abduction.

There is shown in FIG. 1, leg holder system **10** according to this invention which enables simultaneous positioning in the abduction and lithotomy dimensions. Leg holder system **10** includes support device **12** for supporting a leg cradle not shown in FIG. 1, but seen in FIGS. 4, 5, and 6. System **10** also includes a clamping device **14**, actuator device **16**, and an operator device, handle **18**. Support device **12** includes a hollow tube **20** which has its proximal end **22** located in clamping device **14** and its distal end **24** at handle **18**. Limiter device **26** shown more completely in FIG. **3**, is mounted at the distal end **24** of hollow tube **20**. Clamping device **14** includes a clamp housing **30** having a recess **32** which receives and clamps a mounting device such as pivot post **34** extending from an x-ray table. Clamp housing **30** is rotatable about axis **36** of pivot post **34** which allows motion in the abduction dimension indicated by arrow **35**.

Clamp housing **30** also includes a bore **38** which receives pressure blocks **40** and **42**. Pressure block **40** has a bore **44** through it which receives the body **46** of pressure block **42**. The enlarged tapered head **48** of pressure block **40** fits in the enlarged tapered bore **50** of clamp housing **30**. Enlarged tapered head **52** of pressure block **42** fits in an enlarged tapered bore **54** of clamp housing **30**. The distal end **56** of pressure block **42** includes threads **58** which mate with threads **60** on locking nut **62**. The enlarged head **64** of locking nut **62** engages one of two oppositely facing Belleville washers **66** and **68** located in recess **69**. Thus, when locking nut **62** is tightened down on pressure block **42** it compresses the Belleville washers **66** and **68**. This causes the tapered portions **48** and **52** of pressure blocks **40** and **42** the force of the Belleville washers to be drawn tightly inwardly against the tapered surfaces **50** and **54** of clamp housing **30**. This wedging effect insures a good tight clamping force which brings clamp housing together by narrowing gap **70** and thereby tightening recess **32** about pivot post **34** and simultaneously wedging pressure blocks **42** and **40** tightly in the tapered recesses **50** and **54**, respectively, so that they are held against rotation in the lithotomy dimension about their central axis **72** as shown by arrow **74**.

Thus, in the normal condition locking nut **62** is tightened down sufficiently to compress Belleville washers **66** and **68** so that a clamping force is applied to prevent rotation **74** about axis **72** in the lithotomy dimension and prevent rotation **35** about axis **36** in the abduction dimension. Release of both of these clamping forces in both dimensions is accomplished simultaneously by rotating handle **18** about axis **80** as indicated by arrow **82**. This rotation causes actuator rod **84** to rotate along with actuator member **86** which is fixed by pin **88** to rotate with rod **84**. Pressure block **42** includes a bore **75** which is larger than but coaxially

aligned with a similar bore **76** in pressure block **40**. The proximal end **22** of tube **20** of support device **12** passes through bores **75** and **76** and is fixed or force fitted in bore **76** so that when handle **18** and tube **20** of support device **12** are rotated up out of the paper as indicated by arrow **77** the entire pressure block assembly including pressure blocks **40** and **42** is rotated with tube **20**.

Actuator member **16** includes two bearing portions **90** and **92** which receive needle bearings **94** and **96** that enable rod **84** to rotate smoothly within tube **20**. Bearing **96** is supported in journal **98** fitted in the end of tube **20**. Between bearing portions **90** and **92** is eccentric portion **100** which also supports a needle bearing **102**. Riding on needle bearing **102** is follower **104** which extends through bore **106** in the proximal end **22** of tubing **20**. The end **108** of follower **104** is cylindrically shaped to engage the cylindrical shape of needle bearing **102**. The other end **110** is concave or cup shaped to engage the spherical tip **112** of set screw **114** which is threadibly engaged in bore **116** of pressure block **42**. Thus, when handle **82** is rotated about axis **80** it rotates the eccentric portion **100** to bear on follower **104** which in turn exerts an outward force on set screw **116**. As a result there is a force directed along axis **72** which opposes the bias of Belleville washers **66** and **68** thereby releases the force of pressure blocks **40** and **42** on tapered portions **50** and **54** of clamp housing **30**. This allows clamp housing **30** to spread somewhat thereby increasing the length of gap **70** so that recess **32** relaxes its grip on pivot post **34** and permits rotation as indicated by arrow **35** in the abduction direction and simultaneously permits pressure blocks **40** and **42** to rotate in the tapered recesses **50** and **54** so that actuator rod **84** and tube **20** of support device **12** can be rotated in a direction out of or into the paper as indicated by arrow **77**.

Thus with one action, the rotation of handle **18** about axis **80**, the clamp releases its grip to allow rotation about both axis **36** and axis **72** to provide simultaneous repositioning in the abduction and lithotomy dimensions. When the handle is released the force of Belleville washers **66** and **68** back-rotate the eccentric, snapping the handle to the normal position and allowing the Belleville washer to reinstate the clamping force on both axes. Covers **120** and **122** may be installed to cover the heads of pressure blocks **40** and **42**, respectively.

The rotation of support device **12** in the direction of arrow **77**, FIG. **1**, is shown in FIG. **2**, where upon the rotation of handle **18** about axis **80** and the application of eccentric **100** to counteract the clamping force of Belleville washers **66** and **68**, the entire support device **12** including tube **20** and the actuator rod **84** have been rotated from the plane of the paper in FIG. **1**, to the upright position where tube **20** and actuator rod **84** are perpendicular to the plane of the paper in FIG. **2**.

The rotational symmetry as well as rotational action may be better understood with reference to the exploded three dimensional view in FIG. **3**. Also shown in FIG. **3** is collar **130** which is held to the end of tube **20** by means of set screw **132** and the limiter collar **26***a* on the other end of tube **20** which is held there by means of set screws **140** and **142**. A circumferential slot **144** which extends less than all the way around the circumference of limiter collar **26***a* receives limiter pin **146** fixed to rotate with actuator rod **84**. A pair of bushings **148** and **150** are mounted on either end of limiter pin **146** after it is mounted in hole **152** of actuator rod **84** to provide for a smoother rotation within slot **144**. It is limiter pin **146** in conjunction with the limited extent of slot **144** that arrests the rotation of actuator rod **84** before it reaches top dead center on the cam so that upon release by the human

operator of handle **18** the handle and actuator rod **84** snap back to the position where they do not oppose the force of Belleville washer **66** and **68** and so the Belleville washers reinstate the fail-safe clamping force on both axes. Handle **18** is rotatably mounted on pin **160** which is mounted for rotation about axis **85** on pin **162**. Pin **62** includes a groove **164** that allows it and handle **160** to rotate about axis **85** but which engages with spring loaded balls **166** and **168** that prevent the handle **160** and pin **162** from being withdrawn from the hollow end **170** of actuator rod **84**.

Although thus far the system can be shown as actuated by mechanical device namely, the action of eccentric **100**. This is not a necessary limitation of the invention, for example, any device may be substituted for eccentric **100** which will exert the opposing force on follower **104** or a similar device to release the action of Belleville washers **66** and **68** on the pressure blocks and clamp pressure blocks **40** and **42** and clamp housing **30**. For example, a hydraulic piston could be installed in place of eccentric **100** driven through hydraulic lines by a foot pedal, for example, which would be remote from the device and external to the sterile drapes. Similarly an electrical device having a movable armature could be used in the same fashion or even a piezo electric crystal or similar device when only small mechanical movements are required.

Typically, in use, two such systems **10***a* and **10***b* are used in conjunction with an x-ray table **180**, FIG. **4**. X-ray table **180** includes two rails **182** and **184** on which slide blocks **186** can be slid into and out of the plane of the paper and tightened at a desired location by handles **190** and **192**. Pivot posts **34***a* and **34***b* extend upward from clamps **186** and **188** into recesses **32***a* and **32***b*, not shown, of clamp housings **30***a* and **30***b*. Mounted on each support device **20***a* and **20***b* are leg cradles (leg holders) **200** and **202** pivotally mounted on axes **204** and **206** which are spaced from the axes **80***a* and **80***b* of tubes **20***a* and **20***b* by support shafts **208** and **210** which are supported in clamps **212** and **214** that are clamped into position on tubes **20***a* and **20***b* by handles **216** and **218**. The lifting of the weight of this system including cradles **200** and **202** and the legs of the patient may be assisted by means of springs or gas cylinders or other devices as symbolically indicated by gas cylinders **220** and **222** mounted to support tubes **20***a* and **20***b* by clamps **224** and **226** and mounted to pivot posts **34***a* and **34***b* by clamps **228** and **230**.

In FIG. **4**, cradles **200** and **202** are in a midrange position with respect to the lithotomy and abduction dimensions. By simply gripping handles **18***a* and **18***b* and rotating them in the direction of arrows **230** and **232** the eccentric members are engaged opposing the Belleville washer force and freeing up and releasing the clamping action on both axes **32***a* and **32***b* and axes **72***a* and **72***b*. Now by simply moving the handles downwardly as indicated by arrows **240** and **242** the cradles **200** and **202**, FIG. **5**, can be moved to a lower position in the lithotomy dimension and may be spread farther apart in the abduction dimension as shown in FIG. **5**, or alternatively the same motion of handles **18***a* and **18***b* in FIG. **4**, which releases the clamp in both dimensions. After the operation of both of them which releases them in both dimensions the handles **18***a* and **18***b* can be moved upwardly to increase the position in the lithotomy dimension and reduce somewhat the position in the abduction dimension as shown in FIG. **6**. In each case upon the accidental or